DOCUMENT RESUME

ED 430 660 JC 990 349

TITLE	Report on Community College Industrial Production Technology Programs.
INSTITUTION	Illinois Community Coll. Board, Springfield.
PUB DATE	1997-00-00
NOTE	27p.
PUB TYPE	Reports - Descriptive (141)
EDRS PRICE	MF01/PC02 Plus Postage.
DESCRIPTORS	*Community Colleges; Curriculum Based Assessment; *Curriculum Evaluation; *Curriculum Research; *Industrial Education; Job Development; Job Training; *Labor Force Development; Labor Needs; *Technology; Two Year Colleges; Vocational Education
IDENTIFIERS	Illinois Community College Board; Illinois Community College System; *Industrial Production Occupations

ABSTRACT

This report provides an in-depth analysis of the Industrial Production Technology Programs in Illinois, which, according to Illinois Community College Board policy, must be reviewed at least once every five years. The disciplines included in this report are: industrial manufacturing technology, corrosion technology, plastics technology, and metallurgical technology. Programs are evaluated in terms of need, cost-effectiveness, quality, and status. The report provides information regarding trends in manufacturing that have affected production occupations, including declining employment, increased international competition, and technological advances that have brought about changes in production techniques and management practices. The result has been a need for more broadly skilled workers who can function flexibly across multiple areas, often as members of work teams. Results were analyzed to determine the extent to which the colleges respond to the changing needs of employers, as well as the level of quality and cost-effectiveness with which they do so. Enrollment in Industrial Production Technology programs decreased by 10% over the five-year review period. Recommendations are presented for consideration, including: (1) programs should be reviewed to ensure they are addressing the skills needed by employers; (2) colleges should pursue enhanced partnerships with high schools, vocational schools, and business and industry; (3) colleges should monitor completions; and (4) colleges should ensure that applicable machining standards are addressed in the curriculum. Contains 13 references. (VWC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED 430 660

Report on Community College Industrial Production Technology Programs

Illinois Community College Board

JC 990349

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.
Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL HAS BEEN GRANTED BY
V. K. McMillan
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

BEST COPY AVAILABLE

Illinois Community College Board

REPORT ON COMMUNITY COLLEGE INDUSTRIAL PRODUCTION TECHNOLOGY PROGRAMS

Table of Contents

	Page
Introduction	1
Trends in Manufacturing that Affect Industrial Production Technologies	2
Industrial Production Technology Programs at Illinois Community Colleges	3
Evidence of Need for Industrial Production Technology Programs	4
Cost-Effectiveness of Industrial Production Technology Programs	9
Evidence of Quality in Industrial Production Technology Programs	10
Status of Industrial Production Technology Programs	13
Summary	14
Recommendations	16
Bibliography	17
Appendix	18

REPORT ON COMMUNITY COLLEGE INDUSTRIAL PRODUCTION TECHNOLOGY PROGRAMS

Introduction

According to policies established by the Illinois Community College Board in 1983, all instructional and student and academic support programs are reviewed at least once every five years at each college. The results of the college reviews are summarized and reported to ICCB staff for analysis. Staff use program review information to prepare an annual *Accountability and Productivity Report* for the ICCB system, as well as to monitor trends and make recommendations for future actions and/or program development. Since 1993, the annual *Accountability and Productivity Report* has been expanded to include information related to the statewide Priorities, Quality, and Productivity initiative that provides a broad institutional context for programmatic and planning issues. In follow up to the *Accountability and Productivity Report*, each year ICCB staff prepare one or more reports that focus on key program areas that were reviewed. This report further examines Industrial Production Technology (IPT) programs from the following CIP classifications that were reviewed during fiscal year 1996:

Industrial Manufacturing Technology	CIP 15.0603
Corrosion Technology	CIP 15.0605
Plastics Technology	CIP 15.0607
Metallurgical Technology	CIP 15.0611

Students in these programs are prepared for a variety of positions, including machine operator, machine maintenance personnel, mold maker, welder, production assembler, inspector, and line supervisor. Occupations related to production technology are spread throughout a number of industries, primarily in the manufacturing sector.

Significant changes have occurred in the U.S. economy and workforce that impact directly on manufacturing-related occupations. New production technologies and management practices focus on integrating manufacturing processes and, as a result, the job skills required of workers. Manufacturing technicians increasingly are expected to have an understanding of computer technology and automated production processes, as well as hands-on skills with production equipment.

Community colleges have implemented curricular revisions for many manufacturing technology programs in response to emerging training needs within the manufacturing sector. In many cases, the changes tend to blur what had been fairly clear distinctions among the types of manufacturing technology programs. Programs in manufacturing technology currently are found in three CIP classifications: 15.04xx - Electromechanical Instrumentation and

Maintenance Technology, which includes Instrumentation Technology, Robotics Technology, and Automated Manufacturing Technology; 15.06xx - Industrial Production Technologies (described above); and 15.08xx - Mechanical Engineering-Related Technologies, which includes Mechanical Engineering Technology and Computer-Aided Design. According to the program review schedule, programs in CIP 15.08xx were reviewed during fiscal year 1994, programs in CIP 15.06xx were reviewed during fiscal year 1996, and programs in CIP 15.04xx are being reviewed during fiscal year 1997. Given the trends of automation and integration of job skills across production industries, the relationship among the programs in these classifications appears to be increasing. Consideration should be given to scheduling the reviews of programs in these classifications for the same year in the next program review cycle. In addition, the classification of all manufacturing-related programs should be reviewed to determine if modifications are needed in response to changes in skills required for manufacturing occupations.

Since community colleges are a vital resource to the businesses and industries in their districts, particularly in the delivery of training and retraining opportunities necessary to maintain a high-quality workforce, it is appropriate to examine Industrial Production Technology program review results in depth to ensure that the colleges are responding to these occupational changes. The results from related program reviews conducted during fiscal year 1994 will be considered where appropriate as well. This report first examines relevant employment trends within the manufacturing sector to provide a context within which to analyze program review information for Industrial Production Technology programs. Next, Industrial Production Technology program review results are presented and analyzed regarding need, cost-effectiveness, and quality. Finally, the analyses are summarized, and recommendations are presented for consideration.

Trends in Manufacturing That Affect Industrial Production Technologies

In an article titled "The Age of Social Transformation" that appeared in the November 1994 issue of *The Atlantic Monthly*, Peter Drucker observes that, "No class in history has ever risen faster than the blue collar worker. And no class in history has ever fallen faster." (p.56) Indeed, this rise and fall is apparent in the changing composition of the nation's workforce over the past three decades. In the 1950s, industrial workers made up two-fifths of the American workforce and enjoyed upper-middle-class incomes, job security, and generous benefits. (Drucker, p. 56) Yet, between 1979 and 1992, manufacturing employment in the U.S. declined by 14 percent, a loss of 3 million jobs. (*Occupational Outlook Quarterly*, Fall 1994, p.27) The loss of manufacturing-related jobs is expected to continue, although at a slower pace. The U.S. Department of Labor Bureau of Statistics projects that the manufacturing sector will have 1.2 million fewer workers in 2005 than in 1994. The vast majority of production occupations are found in manufacturing industries. As expected, the number of workers employed in production occupations has declined significantly since 1979 and is projected to continue to decline over the 1994-2005 period by 294,000 jobs.

The preceding statistics can, however, be misleading. The manufacturing sector still provides employment for over 18 million workers, or one of every seven, in the economy. In 1994, 10.4 million workers were employed in production occupations. They accounted for 8 percent, or approximately one of every 12, workers in the economy. And, although the size of the workforce has declined, the productivity level of the manufacturing sector has remained relatively stable at approximately 30 percent of the nation's total output of goods and services, due in large part to automation of production processes. (*Occupational Outlook Quarterly*, Fall 1996, pp. 48-49)

Advances in technology have been the catalyst for much of the change in the manufacturing sector, in general, and production occupations specifically. Technological advances in transportation and communication have created a world marketplace in which U.S. manufacturing firms face increasing international competition. This increased competition coupled with the increased importance and sophistication of computers in the workplace has led American firms to rethink their production techniques and management practices. This, in turn, has led to an emphasis on flexible production techniques that require workers who are more broadly skilled. (*Occupational Outlook Quarterly*, Fall 1994, p. 35) Increasingly, production workers need to possess the communication, interpersonal, and problem-solving skills to function effectively as a member of a production team, as well as the technical skills to use computers and computer-controlled machinery. Job opportunities in production occupations will be the most favorable for individuals who acquire these skills. The next section of this report analyzes Industrial Production Technology programs offered by Illinois community colleges to determine the extent to which the programs respond to the changing needs of employers, as well as the level of quality and cost-effectiveness with which they do so.

Industrial Production Technology Programs At Illinois Community Colleges

Illinois is among the leading states in the nation in manufacturing. In fact, manufacturing accounts for 19 percent of the state's gross product and employs 17 percent of the state's workforce. (*Horizons*) Food processing is the largest manufacturing activity in the state, with several of the nation's largest food-processing firms headquartered in the Chicago area and plants in Decatur that process massive quantities of corn and soy beans. Other major industries include the manufacture of construction and farm machinery and machine tools, chemicals, and electronic equipment. (*The World Book Encyclopedia*, 1994) In addition, a number of smaller companies are suppliers to these large industrial firms. As these industries respond to increased competition and technological changes, the need to train incumbent production workers and retrain current workers in new technologies and organizational schemes is crucial. Many mid-size and small firms do not possess the resources to provide needed training in-house and look to community colleges to provide programs that will equip workers with the necessary skills to remain productive in a changing workplace.

Associate in Applied Science degrees and basic and/or advanced certificates in one or more of the disciplines within the Industrial Production Technology area (CIP 15.06xx) are offered in 21 of Illinois' 40 community college districts. Nearly half of the Industrial Production Technology program offerings are in college districts in the Chicago area, the nation's second largest manufacturing region. Eighteen colleges reviewed Industrial Production Technology degree and certificate programs during fiscal year 1996. An analysis of the results of the program reviews for Industrial Manufacturing Technology, Plastics Technology, and Metallurgical Technology follows. The analysis focuses on three key indicators examined during program review: need, cost-effectiveness, and quality. Only one program in Corrosion Technology was offered. The program review results from this program were omitted from the following analysis, since the program has been in operation for only two years. It was developed by Moraine Valley Community College in response to a request from industry representatives for a degree for employees needing to upgrade skills related to nondestructive testing. Enrollments have not met expectations, but the program advisory council recommended that the program remain active for at least one more year while council members marketed it within the region's industry in an effort to increase enrollment. The college recently withdrew the program.

Evidence of Need for Industrial Production Technology Programs

Enrollments. For the review period fiscal year 1991 to fiscal year 1995, enrollments in all Industrial Production Technology programs declined by 10 percent (from 1,382 to 1,243), compared to a 4.9 percent decline in enrollments for all occupational programs.* (See Figure 1 below.)

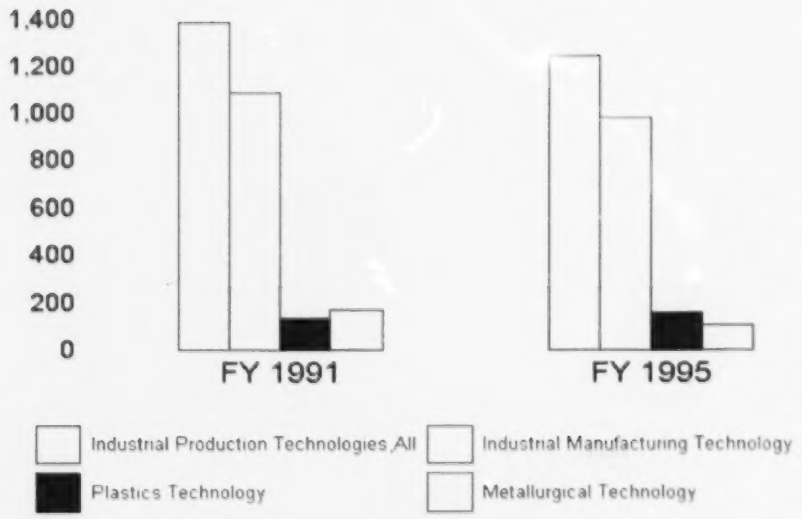

Figure 1. Industrial Production Technologies Enrollments FY 1991 - 1995

*Source for enrollment data: ICCB A1 submission.

As Figure 1 indicates, enrollment activity for the five-year review period differed among the three disciplines within Industrial Production Technology. The bulk of Industrial Production Technology enrollments were in Industrial Manufacturing, which declined by 9.6 percent. For the two smaller disciplines, enrollments in Metallurgical Technology declined by slightly more than 36 percent, while enrollments in Plastics Technology increased by 19 percent.

Table 1A, B, an C in the Appendix provides fiscal year 1991 to fiscal year 1995 enrollment figures in each of the three disciplines by college. Enrollment declines for programs in Industrial Manufacturing and Metallurgy may be a reflection of the fact that the occupations for which these programs train students are sensitive to the economy. When the economy is strong, employees in manufacturing industries are more likely to be required to work overtime, leaving them less time to enroll in weekend or evening classes. This may not affect colleges uniformly, however, due to fluctuations in local economies. Several colleges projected that enrollments in Industrial Production Technology programs will increase due to expected job openings in their respective regions. For Industrial Manufacturing programs, all colleges with low or declining enrollments indicated plans to increase recruitment and marketing efforts. Danville Area Community College planned to begin participation in an apprenticeship program and expected Industrial Production Technology enrollments in the Manufacturing Engineering Technology program to increase as a result. Olney Central College indicated that there may not be enough demand for its program in Metallurgical Technology (welding) to warrant continuation of the entire degree program. Review of the program continues during fiscal year 1997, with consideration being given to inactivating the degree program in welding and enhancing the certificate program. The college will include its decision on this matter in its 1997 program review report. The colleges that provide programs in Plastics Technology reported an expectation that enrollments will remain stable or continue to increase due to a high demand for employees skilled in this area.

In general, the college reviews indicated that very few students in Industrial Production Technology programs are recent high school graduates. Most colleges indicated plans to strengthen Tech Prep relationships with high schools and vocational schools and to increase recruitment efforts among high school graduates. Many manufacturers that offer good pay, benefits, and growth opportunities are not hiring individuals with only a high school diploma. Without additional occupational training, high school graduates entering jobs in the manufacturing sector are likely to find themselves in low paying, low skills jobs, if they are hired at all. Where the area job market warrants, colleges are strongly encouraged to pursue enhanced partnerships with high schools, vocational schools, and business/industry in order to increase the number of students, particularly recent high school graduates, in Industrial Production Technology programs and provide them with the high-level skills that will increase the level of their employment opportunities.

Completions. There were 48 completions in Industrial Production Technology programs during fiscal year 1995 -- 31 in Industrial Manufacturing, 13 in Plastics, and 4 in Metallurgy. Completion data by college for each discipline are presented in Table 2A, B, and C in the Appendix. This represents an overall decline of 46.7 percent in the number of completers in

Industrial Production Technology programs since fiscal year 1991.* Overall, figures are driven by changes in Industrial Manufacturing. The number of completions in Industrial Manufacturing showed a decline between fiscal years 1994 and 1995 (from 55 to 31, or -43.6 percent). (See Figure 2 below.) None of the colleges reported any particular circumstance within the manufacturing sector that might account for such a precipitous decline in

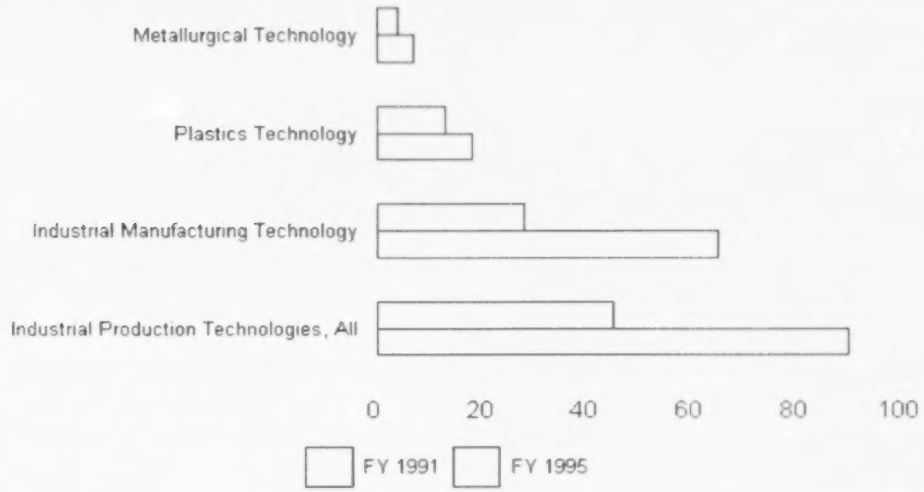

Figure 2. Industrial Production Technologies Completions FY 1991 - 1995

completions from fiscal year 1994 to fiscal year 1995. The sudden decline in completions may be tied to an enrollment decline in Industrial Manufacturing of over 30 percent from fiscal year 1992 to fiscal year 1993. However, colleges, where the number of completions declined significantly, should carefully monitor the number of completions for Industrial Manufacturing Technology programs for the next few years.

*Source for completion data: ICCB A1 submission.

Of greater concern than the decline in the number of completers in Industrial Production Technology programs over the five-year period is the fact that the ratio of completions to enrollments for Industrial Manufacturing and Metallurgy programs is significantly lower than for all occupational programs. Throughout the five-year review period, there was approximately one completion for every ten enrollments for all occupational programs. The ratio of completions to enrollments for Plastics Technology programs was comparable over the same period (one completion to seven enrollments for fiscal year 1991 and one to twelve for fiscal year 1995). In contrast, for Industrial Manufacturing Technology programs in fiscal year 1991, there was approximately one completion for every 15 enrollments. The ratio declined to one completion for every 25 enrollments in fiscal year 1995. There was one completion for every 25 enrollments for Metallurgical Technology programs throughout the five-year period. This suggests that colleges should examine their curricula in Industrial Manufacturing and Metallurgy to determine if current degree and/or certificate program requirements exceed the needs of most students. If the students who leave before completing their program have achieved their educational goals, then they may be better served by a series of short certificate programs targeted at specific skills that may be combined toward a degree, if appropriate. Alternatively, there may be a need to offer only courses and not programs in these disciplines.

Job Placement. For the 1995 Occupational Follow up Survey, 71 graduates of Industrial Production Technology programs were surveyed. Forty-five graduates responded to the survey -- 39 from Industrial Manufacturing, 3 from Plastics, and 3 from Metallurgy. Almost 43 percent of the respondents reported they held their current position prior to enrolling in the program. Nearly all (97.8 percent) of the respondents were employed, and this group reported the second-highest level (93.2 percent) of training-related employment of all occupational areas surveyed that year. Hourly salaries for the group averaged $15.35, compared to an average of $10.66 per hour for all occupational groups surveyed in 1995. A number of colleges reported a 100 percent placement rate for Industrial Production Technology graduates. In addition, Danville Area Community College reported that it is very common for students to be hired prior to completion of the program, which undoubtedly contributes to a low number of completions. Colleges should investigate the extent to which students leave their program of study to accept new employment or a promotion in an occupation related to their field of study. If this is a common occurrence, it reinforces the need to examine curricula to determine if the length of programs is appropriate for the specific needs of students and the industries that

employ them.

Labor Market Demand. In general, occupations related to Industrial Production Technology are concentrated in industries that are sensitive to economic activity, and employment outlooks may fluctuate accordingly. In addition, employment outlook in these occupations is tied to increased foreign competition and improvements in manufacturing technology.

Production workers are classified into three groups by skill -- precision production workers; machine setters, set-up operators, and tenders; and hand workers, including assemblers and fabricators. Figure 3 indicates the distribution of all production workers in the U.S. among the three classifications. (*Occupational Outlook Quarterly*, Fall 1996, p. 48)

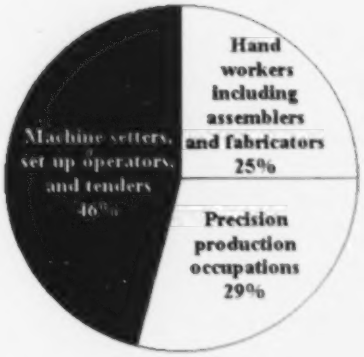
Hand workers including assemblers and fabricators 25%
Machine setters, set up operators, and tenders 46%
Precision production occupations 29%

Figure 3. Distribution of Employment of Production Workers by Skill Level, 1994

The large number of occupations within the area of Industrial Production Technology and their dispersal across many industries make the labor market information difficult to pinpoint precisely. *Horizons* provides occupational outlook projections in Illinois for several occupations commonly found in Industrial Production Technology. For all occupations in this area, job openings will be due largely to the need to replace experienced workers who leave the labor force, not to growth in the occupation. For molders, machine operators, and numerical control machine operators, the outlook is for balance between supply and demand. Molders with experience in plastics will have an advantage in the job market, a statement that is consistent with high demand that the colleges report for graduates of the Plastics Technology programs. A slight surplus exists for drill press operators and welders. This is consistent with the reports from colleges regarding welding programs. While some programs have stable enrollments, one college is considering inactivating its degree program, due to declining employment opportunities in the region, and three colleges reported the elimination of welding certificates in their fiscal year 1996 program review summaries. Most welding programs are included in the Precision Metal (CIP 48.05xx) program classification. Programs in this classification were reviewed during fiscal year 1994. Results of the fiscal year 1994 review showed welding graduates had an unemployment rate of 13.8 percent, nearly one-third who were employed were working in jobs unrelated to their training, and there was a continuing oversupply of individuals completing welding training, while employment opportunities were declining. In the *Fiscal Year 1994 Accountability and Productivity Report*, it was recommended that colleges with multiple degrees or certificates in welding analyze the need for all of the programs to serve the local job market. The welding certificate eliminations reported in the fiscal year 1996 review quite likely resulted from this recommendation. A slight shortage is indicated for tool and die makers and machinists. Some programs that train individuals for these occupations are also included in the Precision Metal classification and were reviewed during fiscal year 1994 with results that were consistent with the results of the Industrial Manufacturing program reviews in fiscal year 1996. In general, employment opportunities are strong, as there will be a large number of job openings in these occupations as experienced workers leave the labor force. This supports the colleges' projections of increasing enrollments in Industrial Manufacturing programs due to an increase in job openings.

In general, there is expected to be a high demand in all of these occupations for workers who possess the high degree of skills needed in an increasingly automated workplace. College reports validated the labor market demand for students who have acquired those skills. As mentioned earlier in this report, 97.8 percent of Industrial Production Technology graduates who responded to the 1995 Occupational Follow up Survey reported working in training-related positions, with higher-than-average hourly wages. Several colleges reported that the number of job openings in Industrial Production Technology-related occupations in the region outnumber the students completing the programs. One college reported that local employers request and pay for courses in the Industrial Production Technology program more often than any other program the college offers. Another indication of labor market demand is the fact that many students are offered training-related employment before they finish their program.

Cost-Effectiveness of Industrial Production Technology Programs

Unit costs for Industrial Production Technology programs increased by an average of 19 percent during fiscal year 1991 to fiscal year 1995, as compared to an increase of 21 percent in unit costs for all occupational programs over the same period. Engineering-related programs (CIP 15.xxxx) are considered more expensive to operate than some other occupational programs, since they typically require large teaching laboratories and expensive equipment.

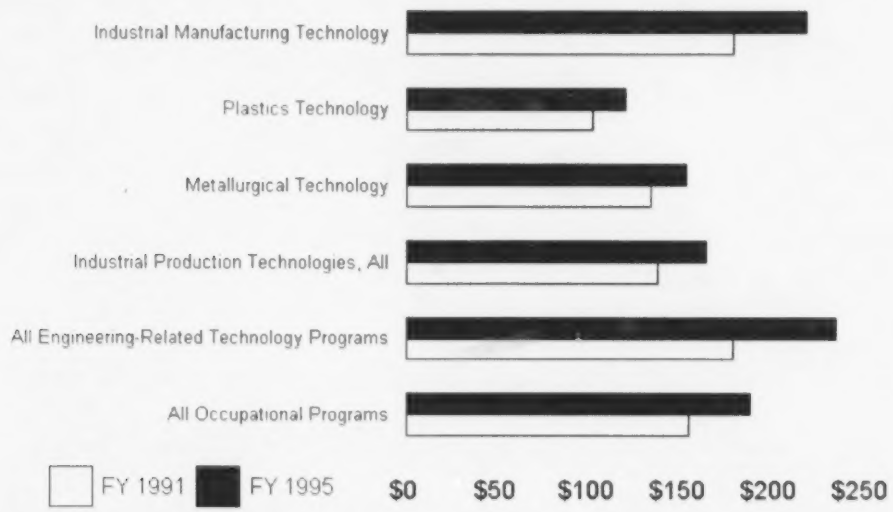

Figure 4. Comparison of Program Unit Costs FY 1991 - 1995

Figure 4 displays the fiscal year 1995 unit costs for Industrial Production Technology programs by discipline, for all engineering-related programs, and for all occupational programs.

For fiscal year 1995, average unit costs for all occupational programs were $187.83, while average unit costs for engineering-related programs were $234.74. For programs in all three Industrial Production Technology disciplines, average unit costs were below the average for all engineering-related programs. Unit costs for programs in Plastics and Metallurgy were below the average for all occupational programs as well. While it is desirable for programs to be cost-effective, a balance between cost and quality must be maintained. It may be that costs in these disciplines are contained somewhat by sharing facilities and equipment with related programs. However, colleges that offer programs in Plastics or Metallurgy should examine the facilities, equipment, and other resources used in the delivery of the programs to ensure that they are adequate to provide the learning opportunities students need to develop skills appropriate to the workplace.

Table 3A, B, and C in the Appendix provide unit costs by discipline for each college for fiscal year 1991 to fiscal year 1995. For the colleges where the unit costs for Industrial Production Technology programs exceeded the statewide average and/or the college average costs for occupational programs, reasons cited included the need for low teacher/student ratios and the cost of equipment for teaching labs. Interestingly, these same two factors, a high degree of faculty/student interaction due to small classes and well-equipped teaching labs, were cited as program strengths as well. One college reported that its Plastics Technology program is not cost-effective because it is a relatively new program. Program costs reflect the start-up costs of hiring a full-time faculty member and equipment purchases. Costs are expected to moderate as enrollment in the program increases. Other colleges where costs exceeded the average reported employing a variety of strategies to moderate program costs, including merging course sections, providing open entry into courses, and sharing courses among related programs. One college reported that the Area Vocational Center facilities are used to teach most of its machine tool classes, and another reported keeping equipment costs low through the solicitation of private donations. While it appears that, in general, Industrial Production Technology programs are cost-effective as compared to other engineering-related programs, colleges should continue to explore opportunities to share resources; i.e., equipment and facilities, with local employers and other providers of vocational education when appropriate in order to keep costs at moderate levels and maximize resources.

Evidence of Quality in Industrial Production Technology Programs

Colleges typically develop curricula for Industrial Production Technology programs in cooperation with advisory committees of local employers, since it is crucial that the programs teach the specific skills needed in the workplace. The high rate of training-related employment reported by Industrial Production Technology completers provides evidence that the colleges have been successful in developing quality programs that meet the training needs of employers.

In response to increased international competition, national emphasis has been placed on developing the U.S. manufacturing sector to a level of standards that will promote competitiveness in the world marketplace. The national/state Manufacturing Standards Pilot Project is intended to introduce world-class standards into existing curricula to reflect industry skill requirements. National/state skills standards for manufacturing occupations will ensure a basic level of skills for the workforce and provide workers with skills that are portable and transferrable. As part of this project, seven Illinois community colleges were selected as pilot sites to work with the National Tooling and Machining Association to develop voluntary standards in the metalworking industry. Skills standards for machining were endorsed by the Illinois Occupational Skills Standards and Credentialing Council in 1996 and will be disseminated to all community colleges in the near future. As a next step, a manufacturing technology articulation panel, including community college representatives, has been convened to incorporate those skills into model curricula and education career ladders. The skills standards provide an additional tool for curriculum development and quality assurance for Industrial Production Technology programs. Colleges should review appropriate Industrial

Production Technology curricula and make modifications, if necessary, to ensure that applicable machining skills standards are included. Further, colleges should incorporate skills standards into other Industrial Production Technology curricula as they become available.

The colleges' reports also contained numerous specific examples of quality indicators related to articulation, curriculum, faculty, facilities/equipment, and responsiveness to local need as follows.

- ***Articulation.*** Several colleges reported that their Industrial Production Technology programs articulate with baccalaureate degree programs. Black Hawk College's Machinist and Mechanical Technology program articulates locally with Western Illinois University's Manufacturing Engineering Technology program. Rock Valley College's Automated Manufacturing Technology program articulates with four-year programs at Bradley University and Northern Illinois University, and Richland Community College's Industrial Engineering Technology program articulates with a four-year program at Eastern Illinois University. Illinois Central College reported that its unique Engine Power Technology program transfers to several universities.

- ***Curriculum.*** Several colleges reported current or planned curriculum revisions that respond to the changing needs of the industrial/manufacturing workplace, as well as other curricular features that provide program quality. Prairie State College indicated a recognition of the need for short-term certificates that reflect the needs of industry in certain areas of specialization. Richland Community College planned to add specialization courses to the Industrial Engineering Technology program in response to needs created by emerging technologies. In addition, obsolete production courses were eliminated from the Industrial Production Technology program, and courses in materials management, computer-integrated manufacturing, and statistical process control have been or will be added. At Elgin Community College, course outlines and syllabi were reviewed and updated in fiscal year 1996 to reflect equipment and software purchases, as well as recommendations from the advisory committee. McHenry County College utilized consultants and advisory committees to complete a two-year study to determine how to best organize and deliver programming relevant to the manufacturing sector in the future. As a result, selected courses from the Industrial Engineering Technology program were to be updated and realigned with a modernized Manufacturing Management program, and the Industrial Engineering Technology will be withdrawn. The curriculum for the Manufacturing Technology program at Heartland Community College was revised to integrate the program with other technology programs in the department. All of the programs will have a common general education core, a common technical core, and a nine-hour elective component of specialized technical courses.

- ***Faculty.*** Courses in Industrial Production Technology programs are taught by both full-time and part-time or adjunct faculty. Colleges commonly identified the quality of the faculty as a program strength. As emerging technologies create changes in

production processes, it is critical that Industrial Production Technology faculty remain up-to-date with current industrial practices. Several colleges reported specific examples of faculty efforts to remain current in the field. At Danville Area Community College, Industrial Production Technology faculty participate in summer Vocational Instructor Practicums. A faculty member from Black Hawk College recently spent six months working in industry to learn current technology. An Elgin faculty member was invited to Russia to train workers there in welding techniques and has, subsequently, incorporated his experiences into the program at Elgin. Other Elgin faculty spent weeks in local industries to determine the relevancy of the content of courses in mold making and found the courses to be sound. A number of the colleges indicated that faculty regularly attend conferences and workshops to keep their skills current. In addition, most part-time faculty are employed in industries that use current technology.

- ***Facilities/Equipment.*** As manufacturing firms move to computer-controlled machinery and automated production processes, it is important that colleges with Industrial Production Technology programs provide students with the opportunity to work with machinery and production processes that reflect current technologies. Laboratory facilities are key to program quality in Industrial Production Technology. Several colleges cited facilities and equipment used for Industrial Production Technology programs as program strengths. Prairie State College reported that its facilities are well-equipped and the equipment is high-tech. Carl Sandburg College's students have access to a state-of-the-art lab for drafting/computer-aided-design classes, and Danville Area Community College's teaching lab contains over $1 million worth of state-of-the-art equipment. Illinois Central College established a teaching factory to simulate work situations and develop problem-solving skills and instituted a major equipment replacement plan. Elgin Community College uses a mix of current and past technology in equipment, since students may encounter both in the workplace. Maintaining up-to-date facilities and equipment for Industrial Production Technology programs is a continuous process, as evidenced by the fact that nearly all of the colleges indicated that the quality of their programs would be enhanced by upgrades of computer software and hardware, acquisition of new and/or replacement equipment, and increased laboratory space.

- ***Responsiveness to Local Need.*** The fact that nearly 100 percent of the Industrial Production Technology completers surveyed for the 1995 Occupational Follow up Survey were employed in training-related positions is a strong indication that, in general, Industrial Production Technology programs are responsive to local employment training needs. Many of the programs were initiated in response to specific requests from local employers and recommendations from advisory committees that include local employers are used in curriculum development. In addition to these general indications of responsiveness to local need, colleges provided more specific examples. In 1994, a survey of employers in the Black Hawk College district projected more than 150 full-time openings for general machinists and automated machinists over the three-year period 1994-1997. In anticipation of this regional need, which

represented a turnaround in the local job market, the college initiated a Machinist program in 1995. Illinois Central College established a Precision Machining Alliance with 20 local certified Caterpillar providers, which developed three pre-apprenticeship programs. Part of the need for this initiative is the expectation that 85 percent of the workforce of one large area manufacturer will retire within the next two years. Rock Valley College reported that one of its priorities is the implementation of a Multi-Skilled Technician program to meet the entry-level employment needs of local manufacturers. These examples are illustrative of the colleges' response to current local employment needs, as well as their proactive response to anticipated employment needs in production occupations.

Status of Industrial Production Technology Programs

Based on the results of program reviews each year, the colleges indicate the status of each degree and certificate program according to the following four categories: (1) continued with minor improvements, (2) significantly modified, (3) discontinued, or (4) scheduled for further review in the coming year.

As a result of program reviews conducted during fiscal year 1996, nine colleges placed their degree and certificate programs in Industrial Manufacturing Technology in category 1, an indication that the programs are of high quality, meet local employment needs, and are cost-effective. Four colleges placed their Industrial Manufacturing Technology programs in category 2, an indication that significant program modifications are planned. All four of the colleges indicated a need to extensively revise curricula to reflect changes in the processes and technologies being introduced in the workplace and to address emerging areas of specialization.

All four colleges that reviewed programs in Plastics Technology indicated that the programs were placed in category 1 and will be continued with only minor improvements. In general, programs in this discipline have sufficient enrollment and produce graduates that are in high demand.

Two colleges reviewed programs in Metallurgical Technology, with mixed results. One college placed its program in category 1. The second college determined that employment opportunities for program completers are declining in the area, and scheduled the program for further review during fiscal year 1997 to determine if sufficient need exists to continue the program. Results of this continued review will be reported in the college's fiscal year 1997 program review summary.

As cited earlier in this report, only one college offered a degree in Corrosion Technology. Due to low enrollments and high costs, this second-year program was placed in category 4 and received further review during fiscal year 1997 as program staff worked with the Advisory Committee to market the program to area industries. The college recently withdrew the program.

Summary

Illinois Community College Board policy requires that all instructional and student and academic support programs be reviewed at least once every five years at each college. Industrial Production Technology programs were reviewed during fiscal year 1996. A summary of the results of these program reviews was included in the ICCB's *Fiscal Year 1996 Accountability and Productivity Report*, and this report provides a more in-depth analysis of the programs as a follow up to the fiscal year 1996 program review. Disciplines included within Industrial Production Technology are: Industrial Manufacturing Technology, Corrosion Technology, Plastics Technology, and Metallurgical Technology. The occupations for which these programs train individuals are spread throughout a number of production industries, most of which are in manufacturing. Accordingly, this report provided information regarding trends in manufacturing that have affected production occupations, including declining employment, increased international competition, and technological advances that have brought about changes in production techniques and management practices. The result has been the need for more broadly skilled workers who can function flexibly across multiple areas, often as members of work teams. Within this context, Industrial Production Technology program review results were analyzed to determine the extent to which the colleges respond to the changing needs of employers, as well as the level of quality and cost-effectiveness with which they do so.

Industrial Production Technology programs, both AAS degrees and basic and advanced certificates, are offered in 21 of the 40 Illinois community college districts. Eighteen colleges reviewed Industrial Production Technology programs during fiscal year 1996. The analysis of Industrial Production Technology program review results focused on three key indicators: need, cost-effectiveness, and quality. Results of the review of the only program offered in Corrosion Technology were excluded from the analysis since the program has been in operation for only two years.

Enrollments in Industrial Production Technology programs decreased by 10 percent over the five-year review period (fiscal year 1991 to fiscal year 1996). The bulk of Industrial Production Technology enrollments are in Industrial Manufacturing Technology programs. In general, the level of enrollment in these programs was found to be adequate, and many colleges expect enrollment growth to occur over the next five-year period. Enrollments in Plastics Technology programs were stable or growing. Enrollments were declining in one of the two Metallurgical Technology programs reviewed, but stable in the other. A general concern was expressed regarding the low number of recent high school graduates who enroll in Industrial Production Technology programs, and colleges indicated plans to increase partnership and recruitment efforts with high schools and vocational schools.

The number of completions in Industrial Production Technology programs decreased by 46.7 percent from fiscal year 1991 to fiscal year 1995, mostly due to a steep decline in the

number of completions in Industrial Manufacturing programs between fiscal year 1994 and fiscal year 1995. Of greater concern is the fact that the ratio of completions to enrollments for programs in Industrial Manufacturing and Metallurgy was significantly lower than the ratio for all occupational programs throughout the five-year period. Colleges reported that many students leave prior to program completion to accept training-related employment or promotions, suggesting that their training needs were met. This suggests the need to examine Industrial Production Technology program offerings to determine whether or not they match the needs of students and employers.

Forty-five Industrial Production Technology graduates responded to the 1995 Occupational Follow up Survey. Nearly all (97.8 percent) of the respondents were employed. Graduate respondents exhibited a high rate of training-related employment (93.2 percent) and earned an average of $15.35 per hour, as compared to an average of $10.66 per hour for all occupational groups surveyed that year.

In general, job openings in most production occupations will be due largely to the need to replace experienced workers who leave the labor force, not to growth in the occupation. The outlook in Illinois for most production occupations is either a balance between supply and demand, or a slight shortage in supply. One exception is welding, where a surplus in supply exists. Program review results indicate adequate demand exists for Industrial Production Technology graduates. In addition to the high rate of training-related employment and above-average hourly wages reported by graduates, several colleges reported that the number of job openings in Industrial Production Technology-related occupations in the region outnumbered the students completing the programs.

Industrial Production Technology programs, in general, appear to be cost-effective. Unit costs for engineering-related programs tend to be higher than the average for all occupational programs. However, costs for programs in Plastics and Metallurgy are actually below the average for all occupational programs. It may be that costs for these programs are held in check by careful management and resource-sharing with other programs, but colleges should review program resources to ensure that they are adequate to maintain an appropriate level of quality. Maintaining up-to-date facilities and equipment that reflect rapidly changing technologies is a challenge for colleges. They are encouraged to develop resource-sharing opportunities with local employers and other providers of vocational education to moderate costs and maximize resources.

Colleges reported numerous specific examples of quality indicators related to articulation, curriculum, faculty, facilities/equipment, and responsiveness to local need. In addition, seven colleges participated in a national/state Manufacturing Standards Pilot Project to develop voluntary standards in the metalworking industry. As a result, machining skills standards were endorsed in Illinois in 1996, and an articulation panel, including community college representatives, is working to incorporate those skills into model curricula and education career ladders. Colleges are encouraged to incorporate the machining skills standards, as well as other state-endorsed skills standards developed in the future, into appropriate Industrial Production Technology curricula.

Based on the results of program reviews each year, the colleges indicate the status of each degree and certificate program according to the following four categories: (1) continued with minor improvements, (2) significantly modified, (3) discontinued, or(4) scheduled for further review in the coming year. Nine colleges placed their Industrial Manufacturing Technology programs in category 1, and the remaining four colleges indicated the need for significant curricular modifications and placed their programs in category 2. All programs in Plastics Technology were placed in category 1. One program in Metallurgical Technology was placed in category 1; the other was placed in category 4 and scheduled for further review during fiscal

year 1997 to determine continuing need for the program. The program in Corrosion Technology was placed in category 4 as well and has, subsequently, been withdrawn.

Recommendations

Based on the analysis of the results of the review of Industrial Production Technology programs, it is recommended that:

1. Consideration should be given to scheduling the reviews of all programs related to Manufacturing Technology (CIP 15.04, 15.06, and 15.08) the same year in the next program review cycle. In addition, the classification of all manufacturing-related programs should be reviewed to determine if modifications are needed in response to changes in skills required for manufacturing occupations.

2. Where employment opportunities exist, colleges are strongly encouraged to pursue enhanced partnerships with high schools, vocational schools, and business/industry in order to increase the number of students, particularly recent high school graduates, in Industrial Production Technology programs.

3. Colleges should carefully monitor completions in Industrial Manufacturing Technology programs. This is particularly important for colleges where the number of Industrial Manufacturing completers declined significantly between fiscal year 1994 and fiscal year 1995.

4. Colleges should examine course-taking patterns of program leavers to determine if consideration should be given to (a) developing appropriate short certificate programs that will meet students' immediate training needs and, if feasible, can be combined toward a degree or (b) offering only courses and not programs in these disciplines.

5. Colleges should continue to develop partnerships with business/industry and other providers of occupational education in order to promote resource sharing and maximize resources.

6. Colleges should review appropriate Industrial Production Technology curricula and make modifications, if necessary, to ensure that applicable machining standards are included. Further, colleges should incorporate skills standards into other Industrial Production Technology curricula as they become available.

Bibliography

Bridges, William. (September, 19, 1994). *The End of the Job.* Fortune, p. 62-74.

Drucker, Peter F. (November 1994). *The Age of Social Transformation.* (Volume 274, Number 5). The Atlantic Monthly, p. 53-80.

Hines, Andy. (January - February, 1994). *Jobs and Infotech: Work in the Information Society.* The Futurist, p. 9-13.

Illinois Community College Board. (1992, 1993, 1994, 1995, 1996). *Data and Characteristics of the Illinois Community College Board System.* Springfield, Illinois: Author.

Illinois Community College Board. (October 1995). *1995 Follow-Up Study of Fiscal Year 1994 Occupational Program Graduates.* Springfield, Illinois: Author.

Illinois Occupational Information Coordinating Committee. (1997). HORIZONS Occupational Information. Springfield, Illinois: Author.

The National Coalition for Advanced Manufacturing. (February 1996). *U. S. Industrial Strength for the 21st Century.* Washington, D.C.: Author.

Richmond, Louis S. (August 22, 1994). *The New Worker Elite.* Fortune, p. 62-74.

U. S. Department of Labor. (Fall 1994). *Manufacturing: It's Still the Industrial Age.* Occupational Outlook Quarterly. Washington, D.C.: Author.

U.S. Department of Labor. (Spring 1996). *The 1994-2005 Job Outlook in Brief.* Occupational Outlook Quarterly. Washington, D.C.: Author.

U. S. Department of Labor. (Fall 1996). *Industrial Employment.* Occupational Outlook Quarterly. Washington, D.C.: Author.

World Book, Inc. (1994). The World Book Encyclopedia. Volume 10. U.S.A.: Author.

The World Future Society. (1994). *An American Renaissance in the Year 2000.* Bethesda, Maryland: Cetron, Marvin.

APPENDIX